Introduction to Human Exposure

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EPA's Air Toxics Activities

- Will reduce air pollution emissions, which
- Will improve ambient air conditions, which
- Will reduce ***exposures***, which
- Will ultimately improve human health.

Background Concepts

- Exposure is ***not*** ambient air concentrations
- Exposure is ***contact*** of an ***individual*** with a ***pollutant*** for specific ***time*** durations
- Individuals exhibit health outcomes based on their exposure

Background Concepts

- For exposure to occur
  - Individual must be present
  - Come in contact with contaminated media,
  - Have pollutant transferred from media to the exposure boundary

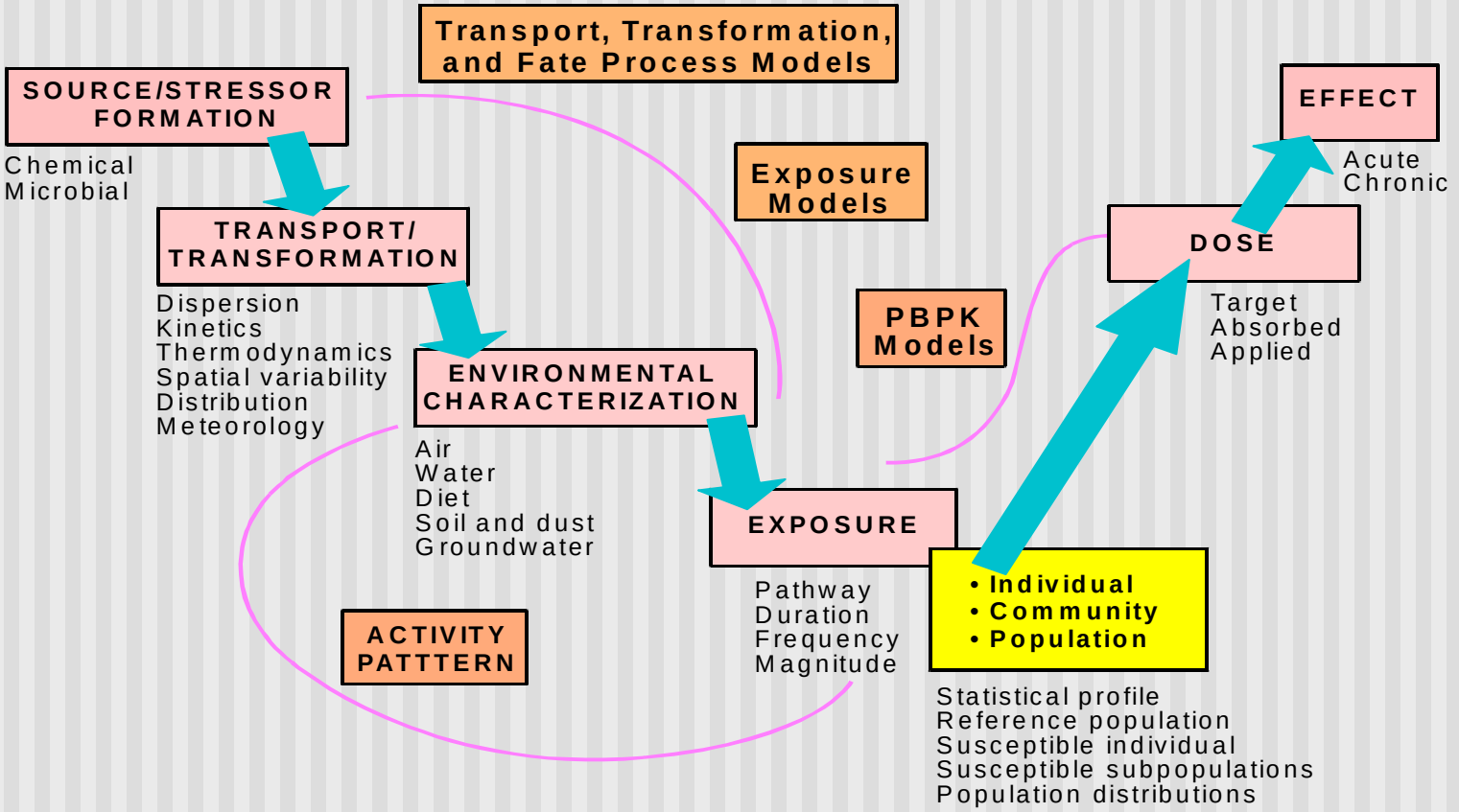
More Definitions

- Aggregate Exposure: exposure to a single stressor across all routes and pathways from all sources
- Cumulative Exposure: aggregate exposure to multiple stressors
- Absorbed Dose: stressor concentration that crosses the body barrier
- Target Dose: stressor concentration at the site of effect
- Biomarker: stressor or metabolite in a biological fluid

Goal for Exposure Research

- Develop the methods, data and models that will allow us to
  - Evaluate the relationship between ambient concentrations and exposure
  - Identify the process and factors that effect this relationship
  - Quantify these factors
  - Estimate distributions of exposure and dose

Scientific Elements of Exposure



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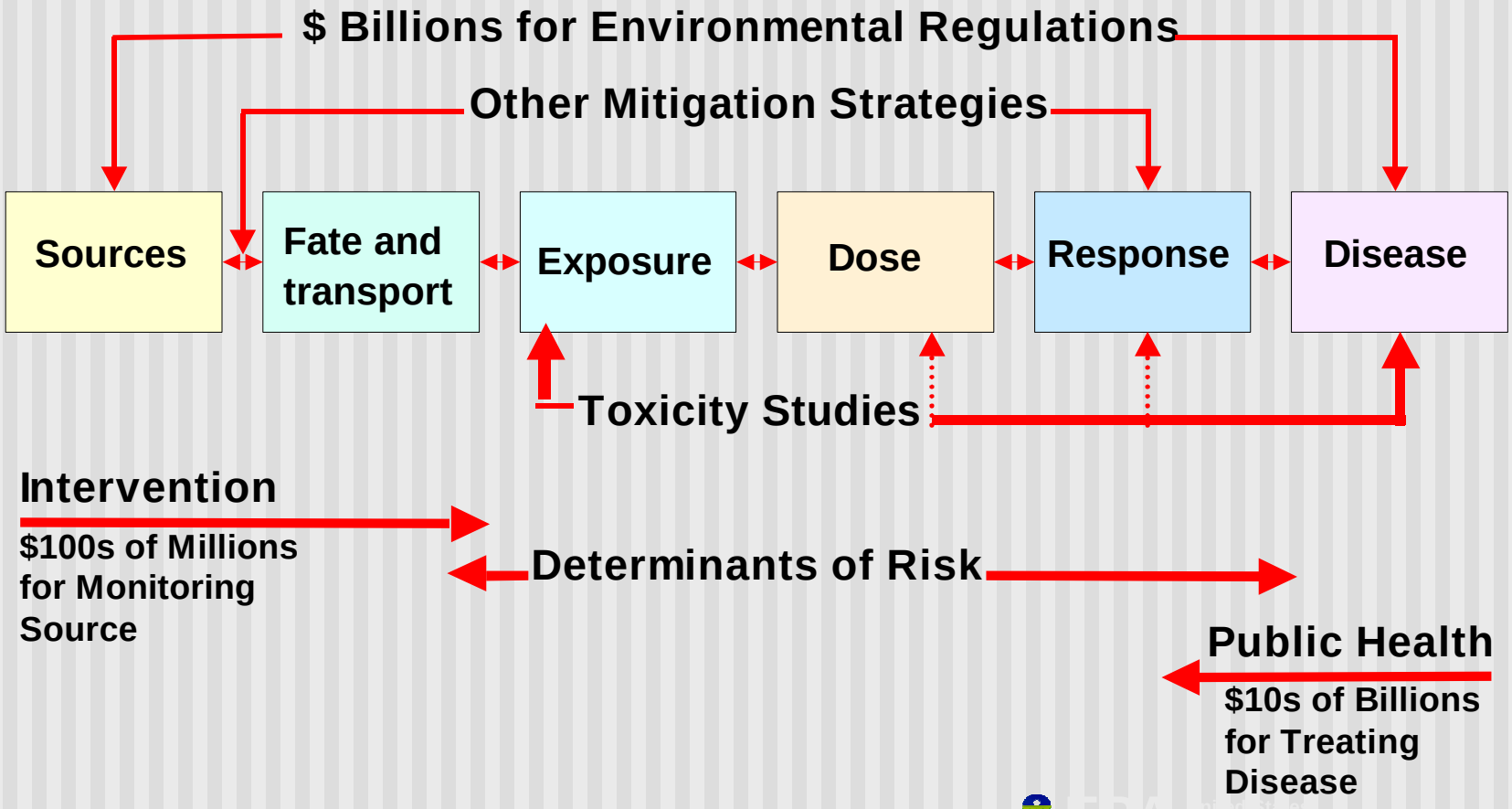
Environmental Health Paradigm



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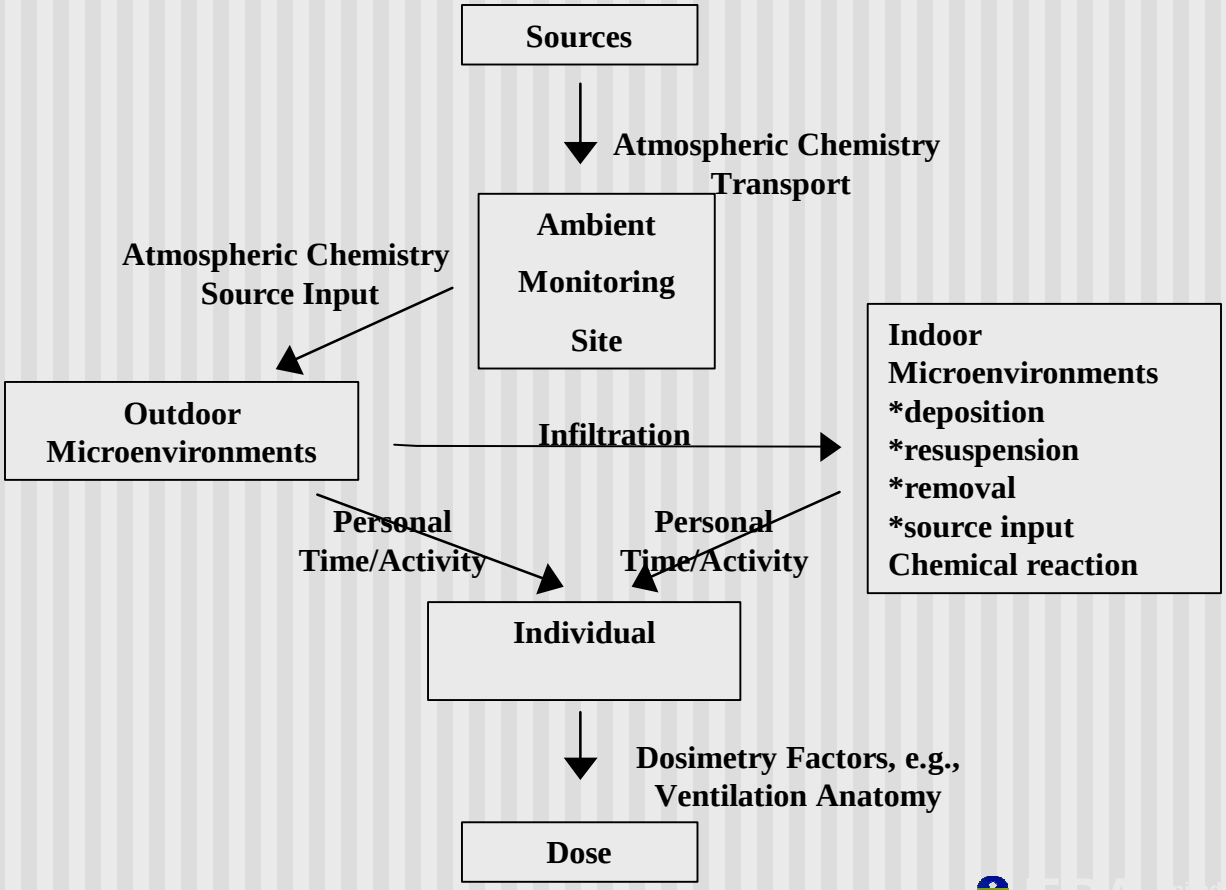
Major Scientific Questions

- Has exposure occurred?
- Who is exposed?
  - General population, susceptibles, high end exposures
- Will the exposure cause a health effect?
  - Intensity, duration, frequency, route, timing
- What can we do to reduce the exposure?
  - Source, route and pathway
- Were we successful (ACCOUNTABILITY)?

Key Elements of ORD's Human Exposure Research

- Develop models, measurements, and methods for estimating exposure and dose
- Distributions and high-end
- General population and susceptibles
- Aggregate -- all sources, all routes and pathways for one chemical
- Cumulative -- aggregate for mixtures
- Address greatest uncertainty/greatest risk

Schematic for Inhalation Exposure



Fundamental Information for Exposure Characterization

- Fate and transport from ambient to microenvironments
- Sources - Identify and characterize ambient and microenvironmental
- Microenviromental media concentrations
- Times spent in Microenvironments
- Transfer Mechanisms
- Quantitation of activities that are responsible for transfer

Iterative Approach for Exposure Characterization

- **Measurement assessments –** directly measure individual contact with the chemical in the exposure media over time.
- **Modeling assessments** uses models and a series exposure factors (i.e., contact duration, contact frequency,) to estimate exposure. Actual measurement data or default assumptions are used.

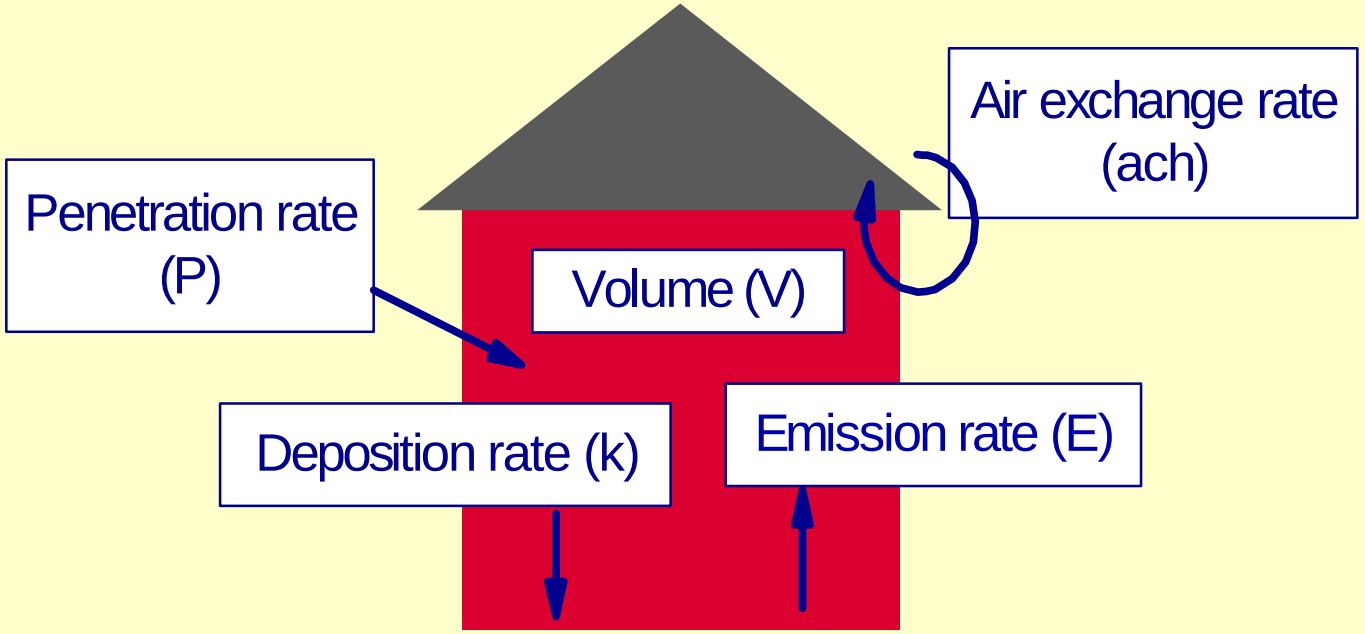
Modeling Assessments

- Exposure Models – sum of exposure in all micro environments

$$E = \sum_j E_j = \frac{1}{T}\sum_j \overline{C}_j t_j,$$

Micrenvironmental Models

$$C_{in} = \left(C_{out} * \frac{P * ach}{ach + k} \right) + \frac{E_{smk} * N_{cig} + E_{cook} * T_{cook} + t * E_{oth}}{(ach + k) * V * t}$$



NERL Exposure Monitoring Approach

- Measure air concentrations
  - Ambient
  - Outdoors
  - Indoors
  - Personal
- Collect data on personal activities and locations, house characteristics, indoor/personal sources
- Characterize the relationships – attenuation factors, penetration factors
- Evaluate the factors that influence these relationships

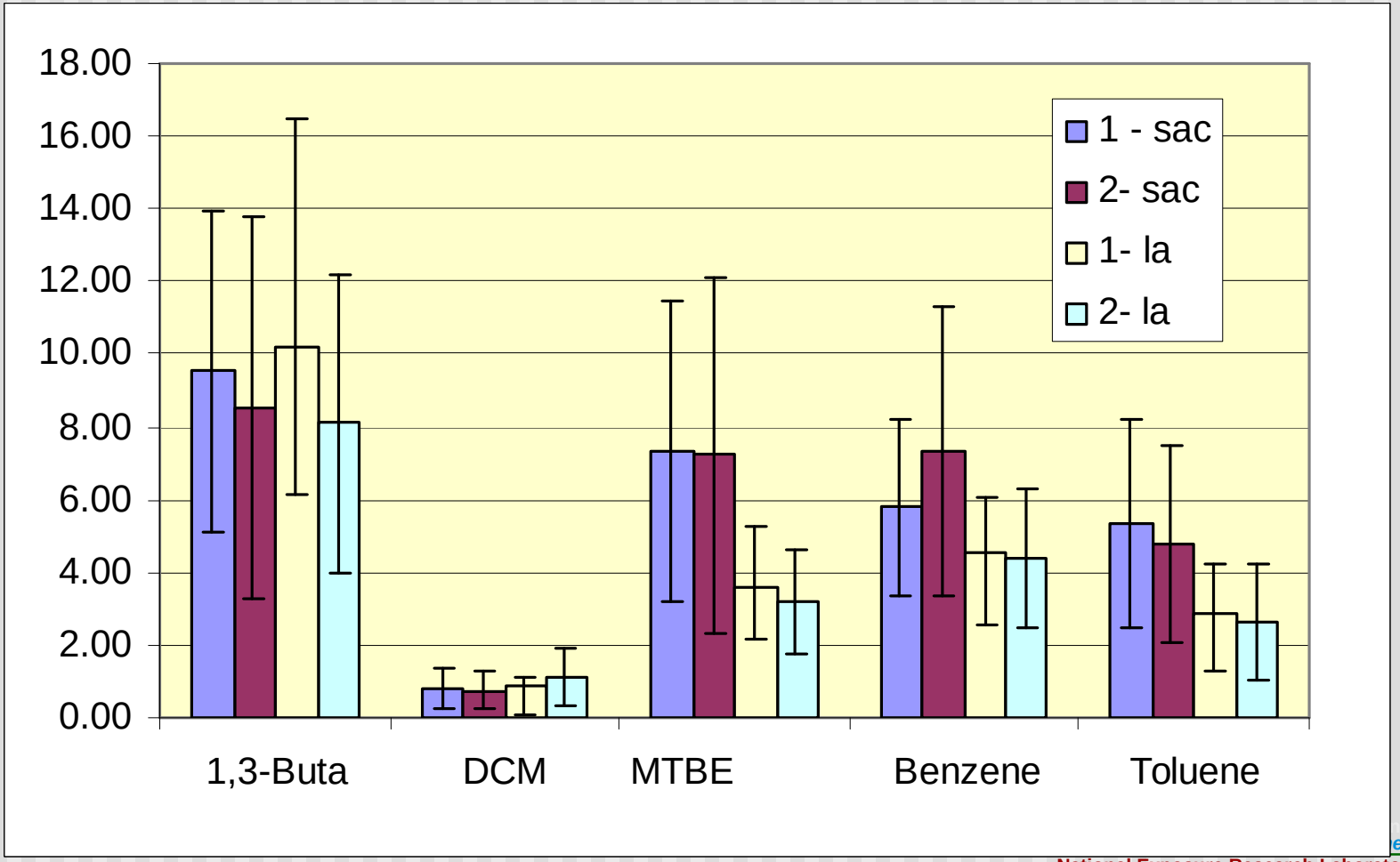
Results of Measurement Studies

- Distributions
  - Air concentrations, air exchange rates, time and activity data, sources, source usage, HVAC operation, building type, building operation
- Estimates
  - Penetration rates, decay rates, emission rates, attenuation factors
- Databases

A Trip Down Memory Lane

- TEAM Studies
- Large Building Studies
- Emissions Testing
- CARB Studies
- RIOPA
- Commuter Studies

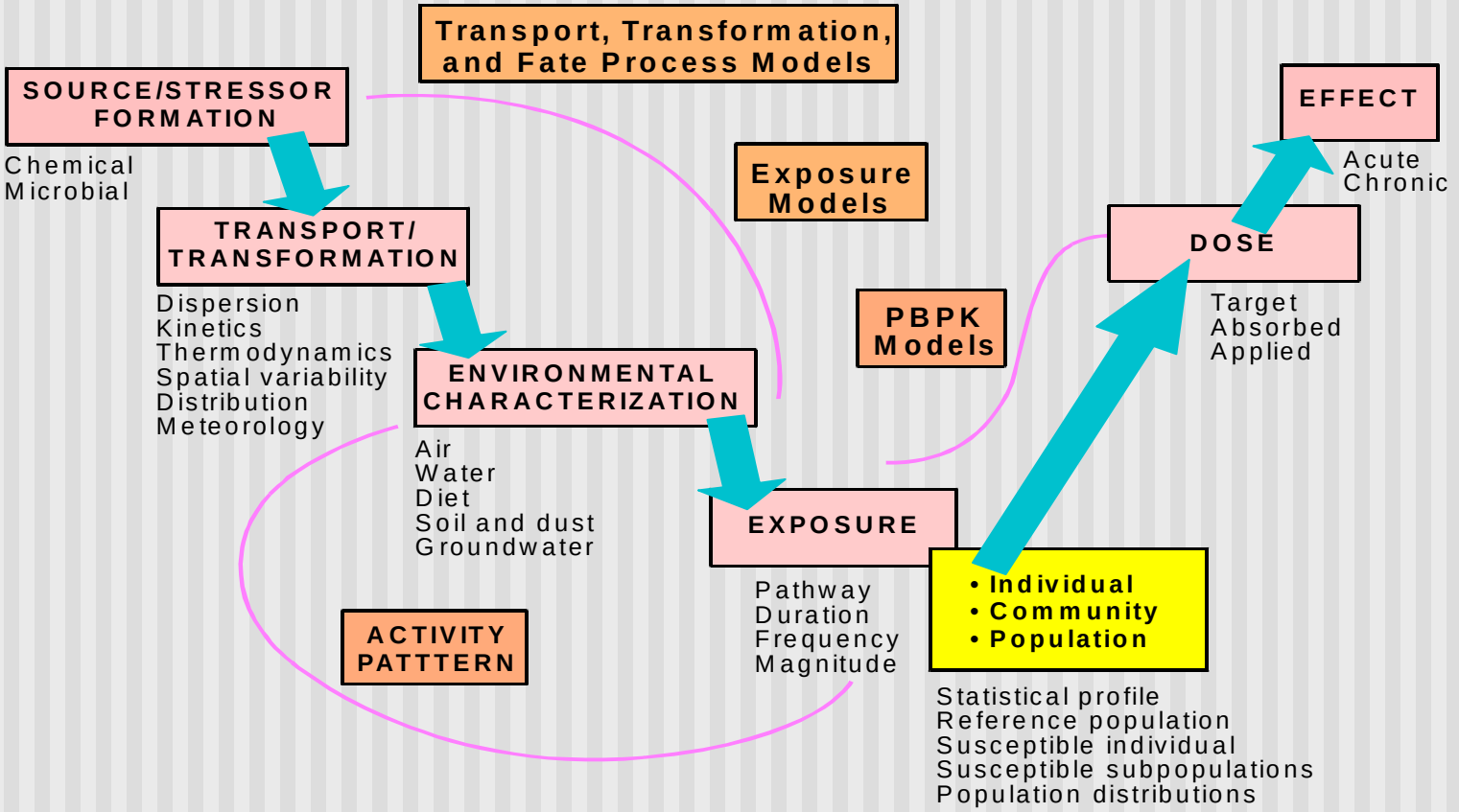
Ratio of Inside Car to Ambient



What's Next?

- Study in Tampa
- Combined Resources from air toxics, asthma, and PM
- Evaluate source to health effects

Scientific Elements of Exposure



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